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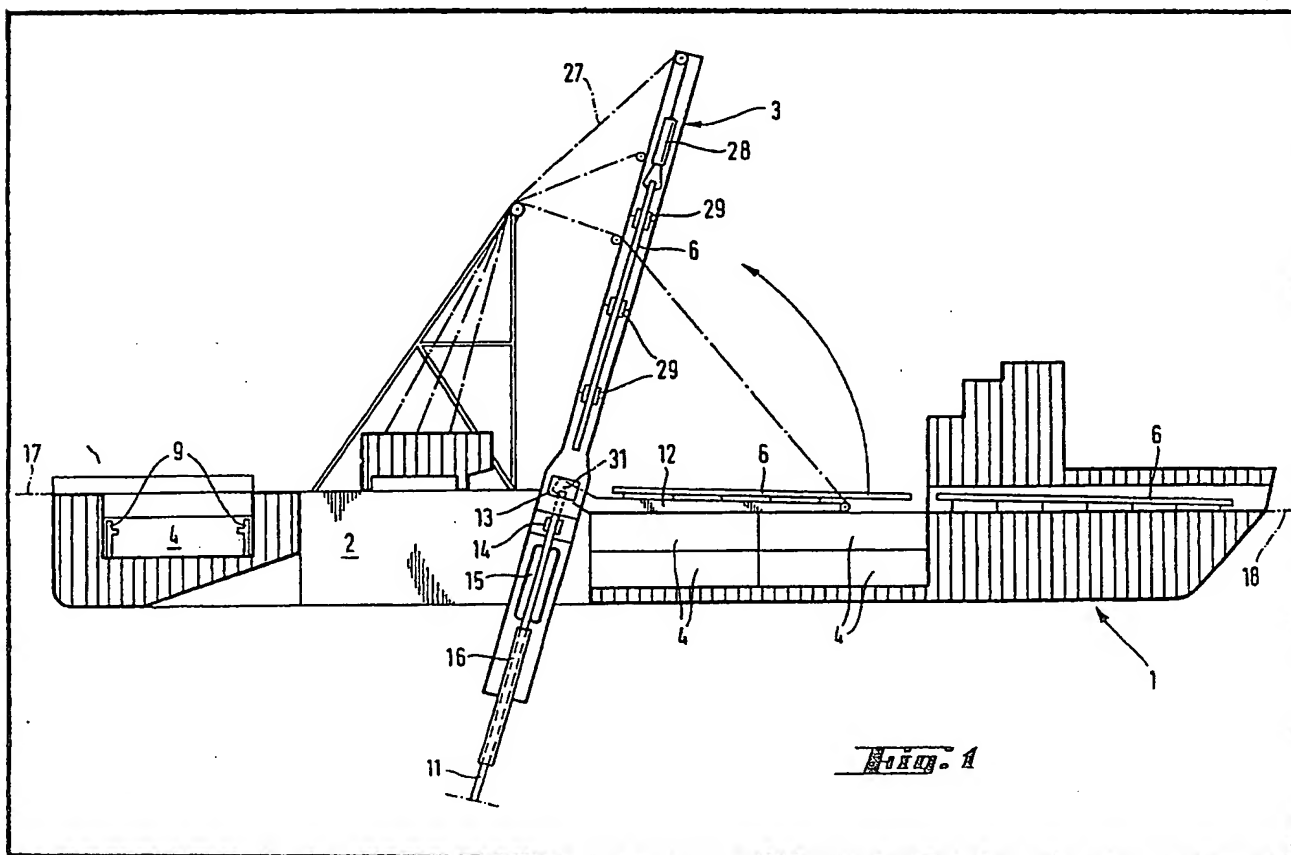
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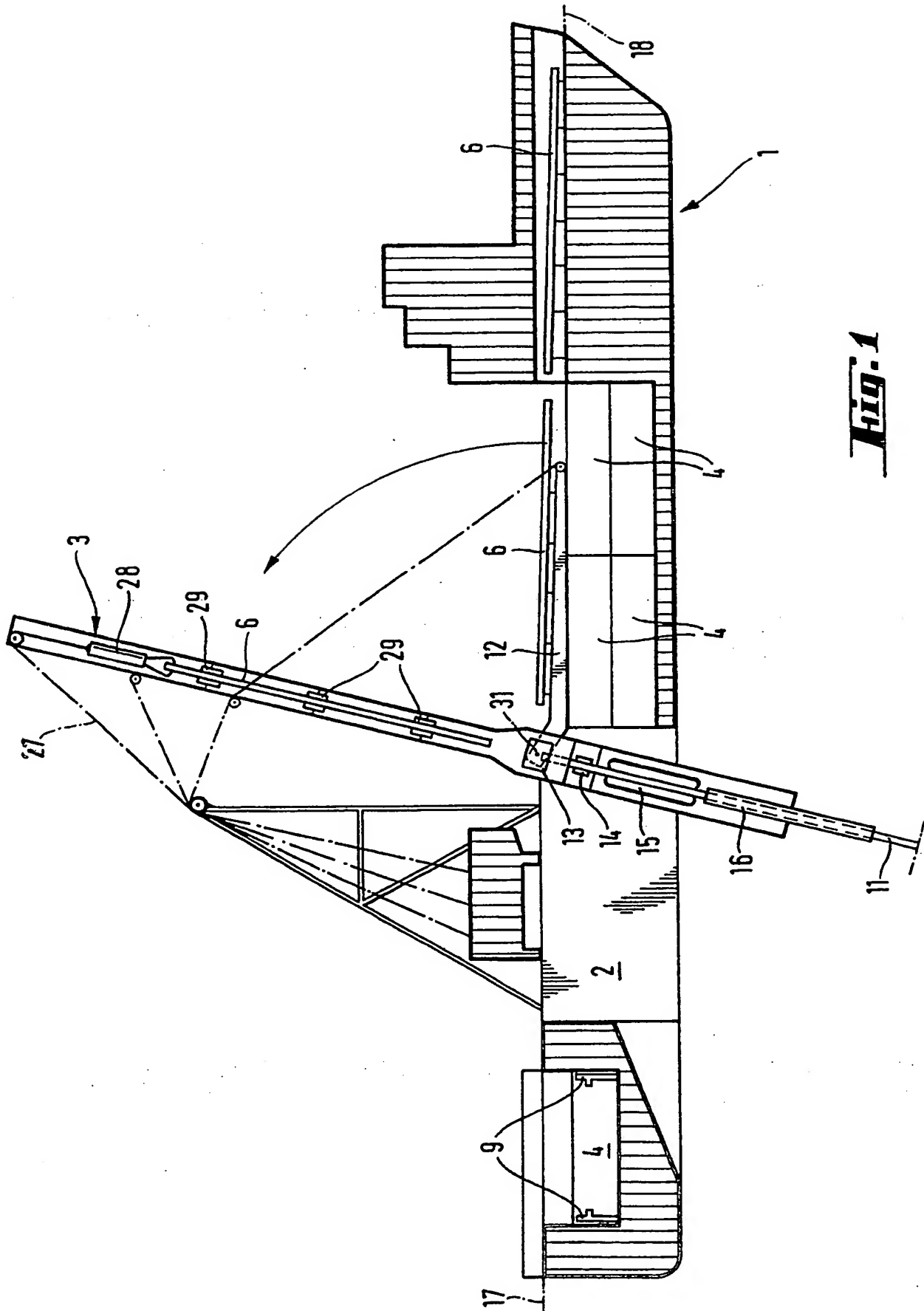
(54) Pipe laying vessel

(57) Individual pipes are taken from storage compartments, and are guided to a welding deck 18 where the individual pipes are welded in pairs into large pipes 6. The large pipes are transferred into a special storage region (22, Fig. 2 not shown) from which they are fed to a swing arm 12 mounted about a horizontal

transverse axis on a laying tower 3. The swing arm 12 is used to raise the large pipes 6 in turn into alignment with the end of a previously laid pipe string 11 and the large pipes are then welded onto the upper end of the pipe string 11. The sleeving of the large pipes is then completed to cover the weld by a sleeving device 14 and a further section of the pipe string 11 is then laid. The laying tower 3 extends through a pipe string shaft 2 at the center of the vessel and features a pipe string holding device 15 and a pipe string support 16 to prevent overstressing of the pipe string. The angle of the laying tower 3 can be varied and its positioning at the center of the ship ensures that the motion of the vessel and the pipe string due to motion of the sea is minimised.



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**Fig. 1**

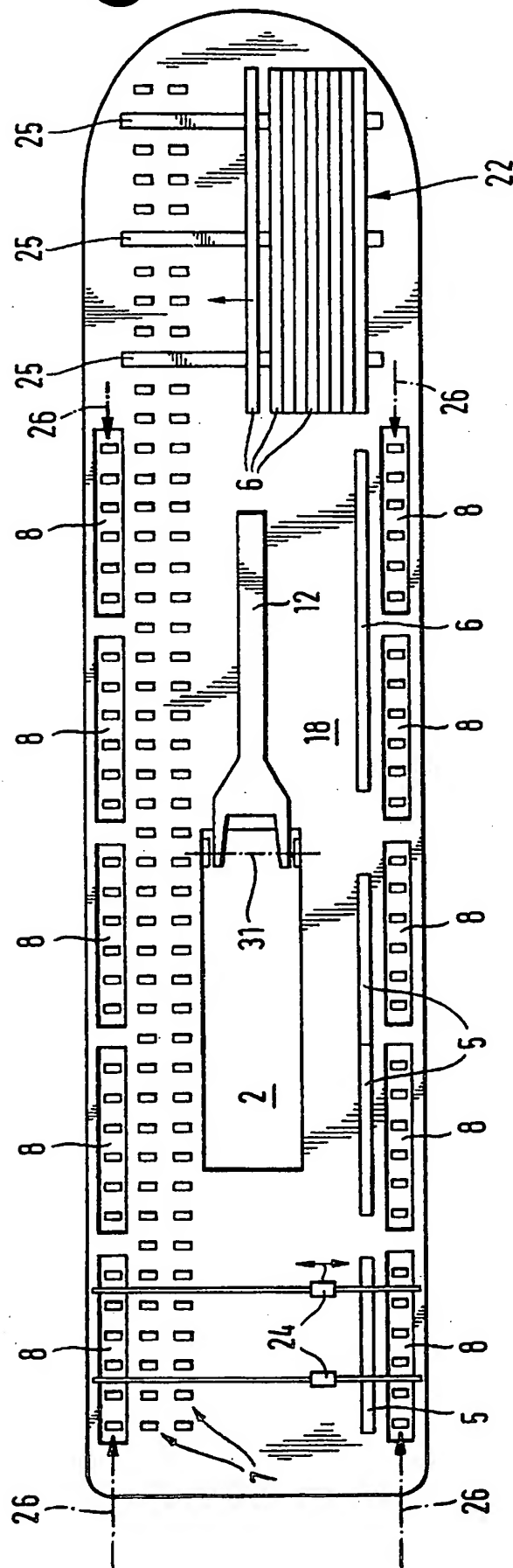
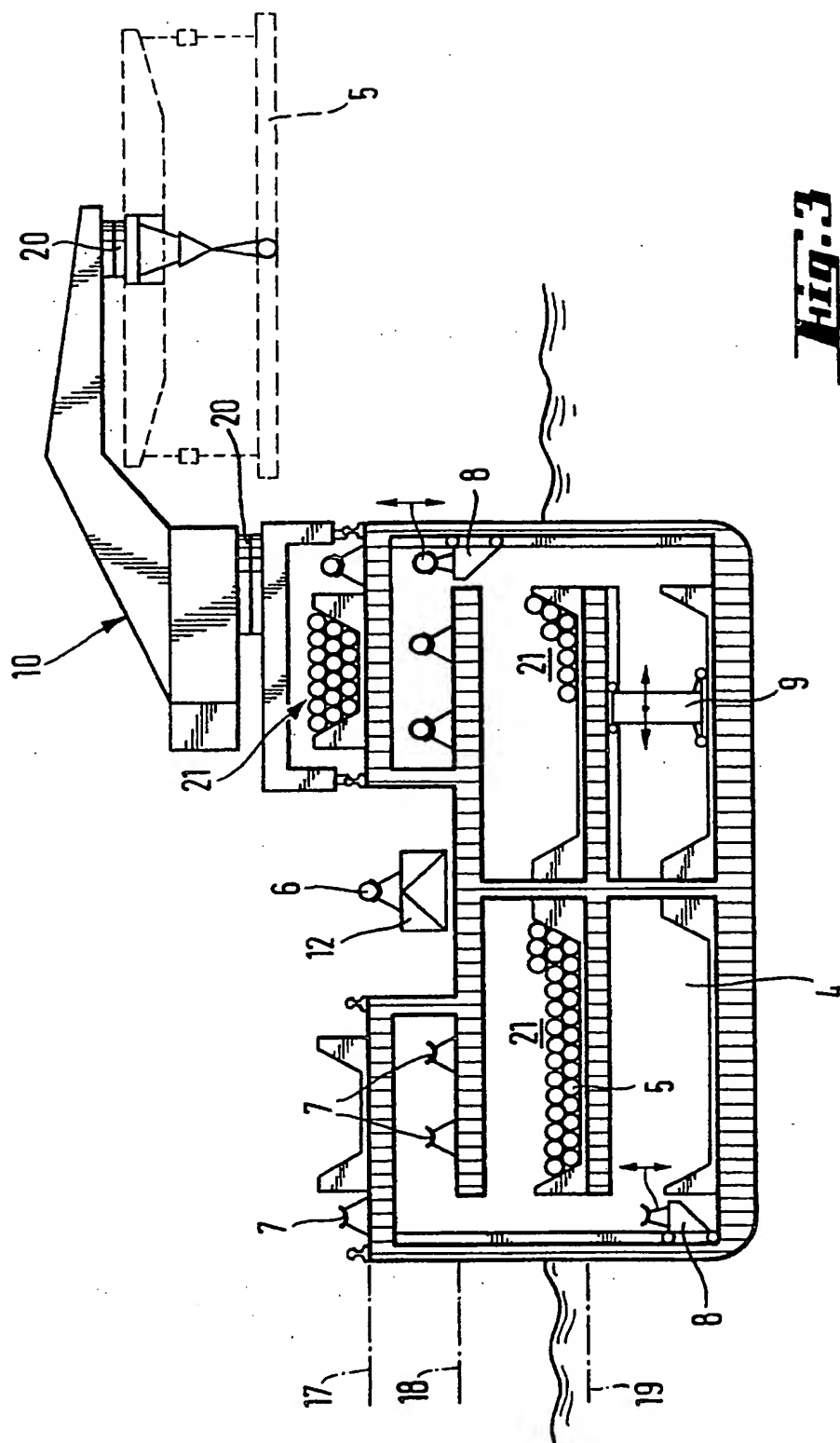
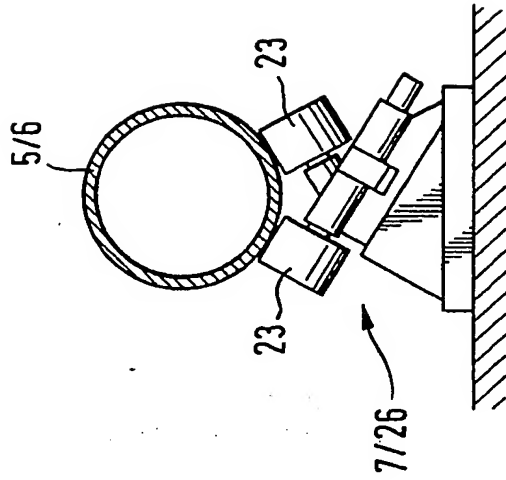
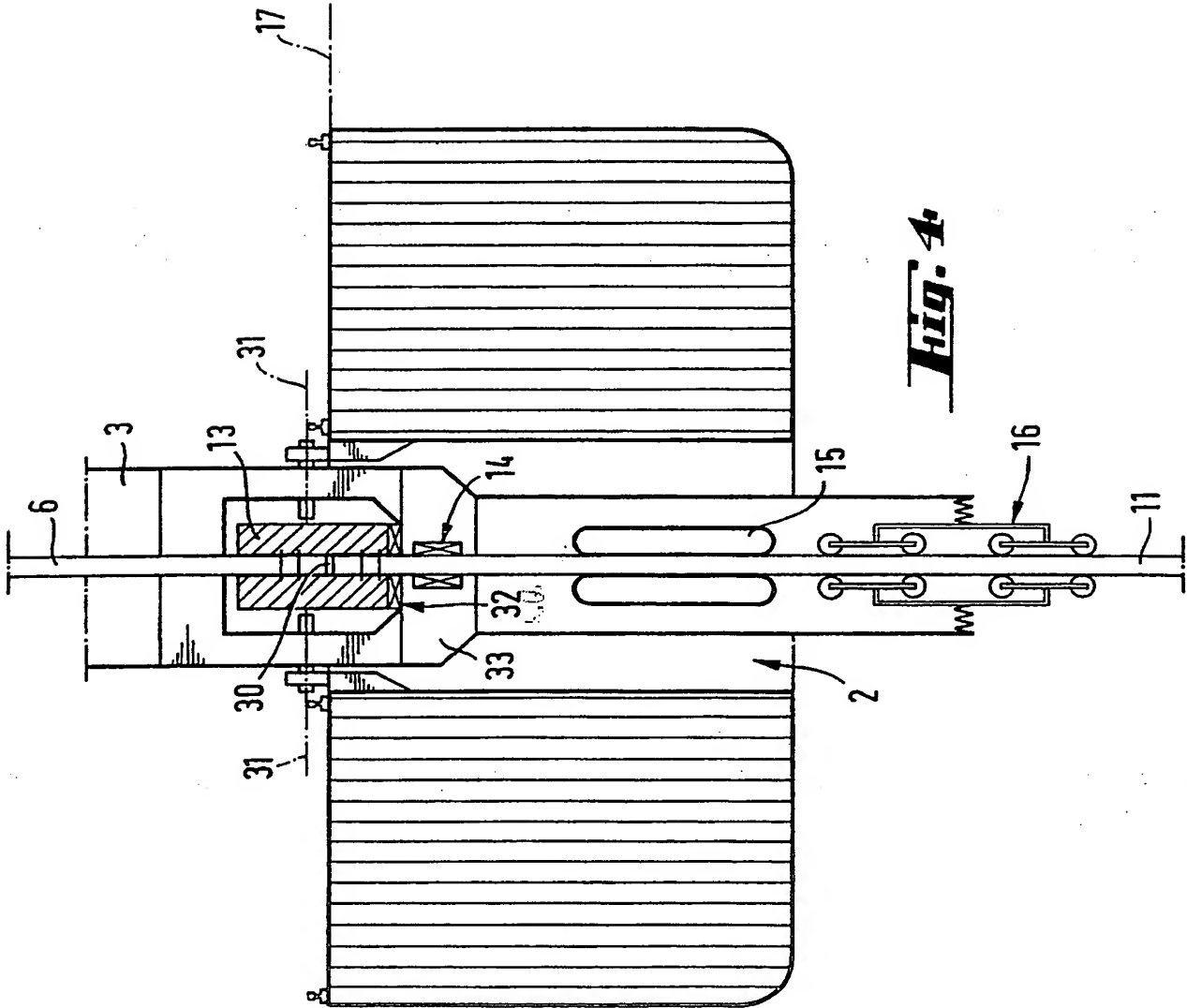


Fig. 2





SPECIFICATION

Pipe laying vessel

The invention relates to a pipe laying vessel for laying a pipe string of large pipes which are continuously welded together, there being forwarding means for taking over, for transporting and for storing the individual pipes, fabrication means for fabricating large pipes and for transporting them into a laying tower, and also an apparatus with a welding plant for laying the pipe string which is extended step by step.

The problem underlying a pipe laying vessel of the above described kind is to make it possible to lay a pipe string, consisting of large pipes which are continuously welded together, without interruption and in an economically advantageous manner. In this connection the pipe string should have a large diameter (40 inches) and a large wall thickness (40 mm) and should be capable of being laid in deep waters.

The solution to this problem resides in the provision, amidships, at the front end of a pipe laying shaft, of a laying tower for J-type pipe laying and, on both sides of, in front of and behind the shaft, compartments subdivided by decks for the transport and storage of the individual pipes and for their assembly to large pipes, together with the associated pipe lanes, pipe hoists, storage compartment cranes and take-over cranes with low swing suspension and/or sea motion follower; and in the provision of a laying tower which holds and guides the pipe string and has a swing arm for placing a large pipe and subsequently by a flash butt welding plant, a sleeving apparatus and a pipe string guide as well as a pipe string support as security against overstressing in the vicinity of the end section of the laying tower.

In a further development of the invention the pipe laying vessel should include a crane deck, a welding deck and at least one storage compartment deck arranged beneath one another in order to have the required compartments available for taking over, storing and fabricating the individual pipes into large pipes.

Furthermore, the pipe transfer cranes on the crane deck should be movable along the vessel on both sides of the pipe string shaft and should be equipped with load turning means which causes the individual pipes to follow a compulsory path of movement into the longitudinal direction of the vessel.

Accordingly, the pipe transport means are also constructed so that, for the purpose of storage and/or treatment on or in the vessel, the pipes are always transported with their axes parallel to the longitudinal direction of the vessel.

The storage for the individual pipes is provided above and beneath the welding deck and the storage for the large pipes is provided at a section at the end of the welding deck.

The fabrication of the individual pipes into large pipes takes place on the welding deck progressing from the rear to the front and is

subdivided into the required treatment of the ends of the pipes, assembly and welding of the individual pipes, post treatment and the preparation of the large pipe for the swing arm of the laying tower.

Preparation of the ends of the individual pipes is only necessary if the individual pipes have been damaged during transport or following renewed separation after a faulty welding step.

The pipe lanes are provided with rollers, for transport in the longitudinal direction of the vessel, and with carriages, bands or the like for transport in the transverse direction of the vessel.

Pipe hoists are arranged at the longitudinal sides of the vessel and are housed below the welding deck for vertical movement of the pipes into the or out of the storage compartments, whereby the pipe hoists located in the welding deck position form a pipe lift lane and/or merely supplement the crane deck pipe lane in the crane deck position.

All pipe lanes are equipped with an electrical monitoring and safety system.

The monitoring and safety system ensures the desired manner of operation. By way of example, a pipe can only be transported along the pipe lane when the pipe hoists are in position level with the pipe lift lane or if route clearance is present for the fixed pipe lanes (in similar manner to the railway).

One or more storage compartment cranes movable transversely of the vessel are provided within the storage compartments and serve to load and unload the pipe hoists.

The laying tower is pivotably supported at the center of the vessel and has a movable gripper carriage for form-locked retention of the large pipe that is supplied, or of the extended pipe string during laying, for example with an associated hoist cable, and also a concentrically operating retaining device for transferring the large pipe into the laying tower and for adjusting the pipe position in the welding position.

The flash butt welding plant is arranged in the pivot axle of the laying tower and includes devices for producing a radial weld bead and also for supplying the required press force and for holding the pipe string.

A station is provided beneath the welding plant for post treatment of the pipe string in the area of the welding zone.

By way of example the sleeving must be supplemented in the vicinity of the weld zone with regard to the maintenance of the cathode protection.

The invention will now be described in more detail with reference to a pictorially illustrated embodiment which shows:

Fig. 1 a pipe laying vessel in accordance with the invention in vertical longitudinal section,

Fig. 2 a plan view on the welding deck of a pipe laying vessel in accordance with Fig. 1,

Fig. 3 a cross-section through the pipe laying vessel of Fig. 1 in front of the pipe string shaft,

Fig. 4 a cross-section as Fig. 3 but in the area of the pipe string shaft, and

Fig. 5 details of a pipe lane in cross-section.

The pipe laying vessel 1 of the invention has a
5 crane deck 17 and also beneath this a welding
deck 18 and one or more storage compartment
decks 19 which serve for the taking-over, storage
and fabrication of the individual pipes 5. A pipe
string shaft 2 is provided amidships, i.e. in the
10 zone in which the movement of the vessel due to
the motion of the sea is smallest. The pipe string
shaft serves to accommodate the pipe string 11
which is held at the front end of the pipe string
shaft 2 by a laying tower 3 which can rotate
15 about a horizontal pivot axis 31 extending
transversely of the ship. The laying tower 3 carries
a swing arm 12 which is likewise pivotable in the
vertical longitudinal plane of the vessel and with
the aid of which the large pipe 6, which is
20 manufactured from two individual pipes 5, can, in
each case, be brought into the welding position
30 opposite the end of the pipe string 11 and held
in this position.

The individual pipes 5 are taken on board the
25 pipe laying vessel 1 from a supply ship (not
shown) with the aid of a transfer crane 10 by
means of a known swing free suspension and sea
motion follower and also a load turning device 20,
with the transfer crane being movable on the
30 crane deck 17 at the sides of the pipe laying
vessel 1 on both sides of the pipe string shaft 2.
The individual pipes are then transported
horizontally with the aid of pipe lanes 7 and pipe
lift lanes 26 and vertically by pipe hoists 8 and,
35 with the aid of storage compartment cranes 9, are
transferred, prepared and welded into large pipes 6,
and are then passed to the swing arm 12 in the
form of large pipes and brought into the welding
position 30 by the swing arm. During the above
40 described sequence of movements on board the
pipe laying ship 1 pipe supports 21 and 22, and
also rollers 23, carriages 24 and bands 25 are
used as customary aids in the above named decks
17 to 19, and in the ship compartments 4 formed
45 by these decks and the customary longitudinal
and transverse bulk heads.

Once the transfer of the individual pipes 5 and
their transport, storage and fabrication into large
pipes having the length of two individual pipes 5
50 has taken place on board the pipe laying vessel as
described above, a large pipe 6 is in each case
mated with the aid of the swing arm 12 to the
end of the already laid pipe string 11 the position
of which is determined by the pipe string guide
55 and the pipe string support 16 of the laying tower
3, in order to avoid impermissible overstressing,
and is connected to the pipe string 11. While this
is being done the laying tower 3 can be
positioned at a variable angle to the horizontal
60 with the aid of a cable. A similar adjustment is
also provided for the swing arm 12.

Once the large pipe 6 has been aligned in this
way relative to the pipe string 11 the flash butt
welding plant arranged at the laying tower 3
65 comes into operation in order to connect the end

of the pipe string 11 with the large pipe 6 and a
sleeving device 14 then comes into operation, in
order to protect this connection against corrosion
and other influences after laying under water by
70 sleeving the weld location.

During this joining step, and during the
application of a protective sleeve, the pipe string
end 11 is held by a holder 32 whereas the large
pipe 6 is held by a gripper carriage 28 movable
75 in the laying tower 3 on a cable 27.

All these steps are monitored and controlled
from the station 33 of the layer tower 3.

It will be appreciated by those skilled in the art
that many variations are possible without
80 departing from the scope of the present claims. In
particular it will be appreciated that although the
preferred embodiment is provided with two
transfer cranes 10 it is also possible to use only a
single transfer crane 10 within the context of the
85 invention.

Claims

1. A pipe laying vessel for laying a pipe string
of large pipes which are continuously welded
together, there being forwarding means for taking
90 over, for transporting and for storing the individual
pipes, fabrication means for fabricating large
pipes and for transporting them into a laying
tower, and also an apparatus with a welding plant
for laying the pipe string which is extended step
95 by step, characterised in that there is provided,
amidships, at the front end of a pipe laying shaft
(2), a laying tower (3) for J-type pipe laying and,
on both sides of, in front of an behind the shaft,
compartments (4) subdivided by decks for the
100 transport and storage of the individual pipes (5)
and for their assembly to large pipes (6), together
with the associated pipe lanes (7, 26), pipe hoists
(8), storage compartment cranes (9) and transfer
cranes (10) with low swing suspension and/or sea
105 motion follower; and in that the laying tower (3)
which holds and guides the pipe string (11) has a
swing arm (12) for placing a large pipe (6) and
subsequently a flash butt welding plant (13), a
sleeving apparatus (14) and a pipe string guide
110 (15), as well as a pipe string support (16) as
security against overstressing in the vicinity of the
end section of the laying tower (3).

2. A pipe laying vessel in accordance with
claim 1 and characterised in that the pipe laying
vessel (1) includes a crane deck (17), a welding
115 deck (18) and at least one storage compartment
deck (19) arranged beneath one another.

3. A pipe laying vessel in accordance with
claim 1 or claim 2 and characterised in that the
pipe transfer cranes (10) on the crane deck (17)
120 are movable along the vessel on both sides of the
pipe string shaft (2) and are equipped with load
turning means (20) which causes the individual
pipes to follow a compulsory path of movement
into the longitudinal direction of the vessel.
125

4. A pipe laying vessel in accordance with
claims 1 to 3 and characterised in that the pipe
transport means are constructed so that, for the
purpose of storage and/or treatment on or in the

vessel, the pipes (5, 6) are always transported with their axes parallel to the longitudinal direction of the vessel.

5 A pipe laying vessel in accordance with one of the claims 1 to 4 and characterised in that the pipe storage (21) for the individual pipes is provided above and below the welding deck (18) and the storage (22) for the large pipes is provided at a section at the end of the welding deck.

10 6. A pipe laying vessel in accordance with claims 1 to 4 and characterised in that the fabrication of the individual pipes (5) to large pipes (6) takes place on the welding deck (18) progressing from the rear to the front and is subdivided into the respectively required treatment of the ends of the pipes, assembly and welding of the individual pipes, post treatment and the preparation of the large pipe for the swing arm (12) of the laying tower (3).

20 7. A pipe laying vessel in accordance with claims 1 to 6 and characterised in that the pipe lanes (7) are provided with rollers (23), for transport in the longitudinal direction of the vessel, and with carriages (24), bands (25) or the like for transport in the transverse direction of the vessel.

30 8. A pipe laying vessel in accordance with claims 1 to 7 and characterised in that pipe hoists (8) are arranged at the longitudinal sides of the ship and are housed below the welding deck for vertical movement of the pipes (5) into the or out of the storage compartments (4), whereby the pipe hoists located in the welding deck position form a pipe lift lane (26) and/or merely supplement the crane deck pipe lane in the crane deck position.

40 9. A pipe laying vessel in accordance with claims 1 to 8 and characterised in that all pipe lanes (7, 26) are equipped with an electrical monitoring and safety system.

45 10. A pipe laying vessel in accordance with claims 1 to 9 and characterised in that one or more storage compartment cranes (9) movable transversely of the vessel are provided within the storage compartments (4) and serve to load and unload the pipe hoists (8).

50 11. A pipe laying vessel in accordance with claim 1 and characterised in that the laying tower (3) is pivotably supported at the center of the vessel and has a movable gripper carriage (28) for form-locked retention of the large pipe (6) that is supplied, or of the extended pipe string (11) during laying, for example with an associated hoist cable (27), and also a concentrically operating retaining device (29) for transferring the large pipe (6) into the laying tower (3) and for adjusting the pipe position in the welding position (30).

60 12. A pipe laying vessel in accordance with

claims 1 to 11 and characterised in that the flush butt welding plant (13) is arranged in the pivot axle (31) of the laying tower (3) and includes devices for producing a radial weld bead and also for supplying the requires press force and for holding (32) the pipe string (11).

65 13. A pipe laying vessel in accordance with claims 1 to 12 and characterised in that a station (33) is provided beneath the welding plant (13) for post treatment of the pipe string (11) in the area of the welding zone.

70 14. A pipe laying vessel in accordance with claims 1 to 13 and characterised in that a pipe string guide (15) is provided for fixing the pipe string (11) in the welding position, which ensures parallelism of the surfaces that are to be welded together, and in that a pipe string support (16) is provided in the region beneath the welding plant to protect the pipe string (11) against

80 overstressing as a result of movements of the vessel and pipe string resulting from the motion of the sea.

15. A pipe laying vessel substantially as herein described with reference to and as illustrated in the accompanying drawings.

Reference numeral list

- | | |
|-----|--------------------------------|
| | 1 pipe laying ship |
| | 2 pipe laying shaft |
| | 3 laying tower |
| 90 | 4 ships compartments |
| | 5 individual pipes |
| | 6 large pipes |
| | 7 pipe lane |
| | 8 pipe hoist |
| 95 | 9 loading compartment crane |
| | 10 transfer crane |
| | 11 pipe string |
| | 12 swing arm |
| | 13 flash butt welding plant |
| 100 | 14 sleeving device |
| | 15 pipe string guide |
| | 16 pipe string support |
| | 17 crane deck |
| | 18 welding deck |
| 105 | 19 storage compartment deck |
| | 20 load turning device |
| | 21 pipe support |
| | 22 storage for large pipes |
| | 23 rollers |
| 110 | 24 carriage |
| | 25 bands |
| | 26 pipe lifting lane |
| | 27 cable |
| | 28 gripper carriage |
| 115 | 29 holding device |
| | 30 welding position |
| | 31 pivot axle |
| | 32 support for the pipe string |
| | 33 station |